and although it had been found not to extend to Seaton Carew, there was no doubt that the eastern and northern borings at South Bank and North Ormesby did not mark the limits of the salt in those directions. The thin coals found in the Seaton boring were regarded by Prof. Lebour as being of gannister or millstone-grit age, and hence of little value except in giving an idea of the structure of the Carboniferous rocks below their red-rock covering. Mr. De Rance's Underground-water Report gave the details of some of these borings, as well as others from Devon, Worcester, Leicester, Lincoln, Lancashire, Hertfordshire, and the south of England. Dr. Embleton contributed a description of *Loxomma Allmanii* from the Northumberland coal-field; Dr. Traquair, of Devonian fishes from Scanmenae Bay and Campbellton, in Canada; and Mr. Smith Woodward, of *Onychodus* from Spitzbergen, and of six new species and two new genera of Liassic fishes. Dr. R. Laing read a paper on a Neolithic interment in Robin Hood Cave, and on the discovery of *Felis brevirostris* in a Pleistocene deposit in the same cavern.

The Section then joined with Section A to hear a joint paper by Profs. Thorpe and Rücker, on the relation between the geological constitution and magnetic state of the British Isles. In this the authors recorded that the magnetic elements had been determined at 200 stations in the United Kingdom, with the result that the declination was found to be subject to local or regional disturbing causes centred in a comparatively small number of spots or lines distributed in various parts of England. The regions mentioned are: (1) the fault-line of the Caledonian Canal; (2) the basalt of the Inner Hebrides; (3) the coal-field of South Scotland; (4) the region of South-East Yorkshire, where the Jurassic rocks are thin; (5) the basalt of Mid-Wales and Shropshire; (6) the line of the "London Palæozoic Ridge"; (7) the basalt of Antrim; (8) the igneous rocks of Connemara. All the principal masses of basalt, and those spots where geologists know or suspect the older rocks to be near the surface, form centres or lines of attraction. As the result of this and of the following reasons, the authors are strongly of opinion that the disturbance is due, not to earth-currents, but to local magnetic rocks, such as basalt, or others like the Malvern diorite, which, though not strongly magnetic in the laboratory, produces a deviation of 20′ of arc even at a distance of a mile from the axis. Only small earth-currents, or none, were detected at such places as Melton Mowbray; and near Reading and Windsor, where the disturbance was great, the earth-currents must circulate *round* the disturbed districts in a manner for which it would be difficult to find an adequate physical cause, while, if the currents are deep-seated, it is not easy to understand the extreme localization of their action. In connection with this paper we may note the exhibition, by Prof. Hull, of a piece of magnetically polar diorite, and a paper by Dr. Edward Naumann, in which he advocated a magnetic survey of the globe, and brought forward a set of results from Japan and elsewhere to show the dependence of magnetic lines on lines of fault, fissure, and elevation. He, however, attributed the magnetic disturbance to the deflection of earth-currents by the great lines of fissure and tectonic disturbance.

Tuesday was chiefly devoted to Pleistocene papers, opened by Dr. Crosskey, who exhibited a large map showing the distribution of Welsh, Lake Country, Scotch, and local erratics. His report described erratics reported by the Yorkshire Boulder Committee and by Mr. Bucknill in Lancashire, and drew attention to (1) the grouping of erratics from special localities; (2) the occasional mingling of groups; (3) the occurrence of high and low level erratics; and (4) the distribution of trails of the latter in accordance with existing physical features. Mr. Whitaker described a deep and steep-sided channel filled with drift in the Cam Valley; Mr. Lamplugh, a new locality for the Arctic shell bed in the boulder clay on Flamborough Head; and Mr. Howorth contributed two papers on which there was considerable discussion. In the first he combated the theory of an ice-cap, on the grounds that many northern lands had no drift, that the southern glaciation was contemporaneous and not alternate with the northern and that in New Zealand and Australia there is nothing corresponding to the drift phenomena of the northern hemisphere, that there is little or no evidence of other earlier glacial periods, that palæontological evidence is against such a theory, and that the advance of ice-sheets over hundreds of miles of plain without any *vis a tergo* is a physical impossibility; in the second, after showing that there is evidence of a connection in Pleistocene times between Siberia and America, not by way of Japan, but probably through the shallow Arctic seas to the north, he considers that the necessary elevation of 25 or 30 fathoms would make the great Siberian rivers flow southward, and terminate in an inland sea stretching east from the Caspian, just as the principal rivers of Russia (Siberia in Europe) now flow into the Black Sea and Caspian. In the discussion it was, however, pointed out that many of the rivers flowed far too rapidly to have their directions thus reversed.

Among the other papers were: one by Prof. Haddon, describing the volcanic and coral deposits of the islands in Torres Straits, where no proof of elevation or of subsidence was to be obtained; one by Mr. Dorsey, on the Witwatersrande Gold-fields; a Report by Mr. Bell, on the manure gravels of Wexford; and one by Dr. F. Clowes, describing rocks at Bramcote and Stapleford cemented by barium sulphate, and the occurrence of the same substance deposited in pipes and water-boxes connected with the pumps of Durham collieries.

On Saturday Mr. Starkie Gardner's report on the Osborne and Bembridge floras of the Isle of Wight and the correlation of the Bovey beds with beds of about Bracklesham age was read, followed by a short paper of Prof. Green's on the concretionary nodules formed by molecular rearrangement into radial crystalline groups of the tufaceous deposits of the magnesian limestone. Mr. Topley next gave an admirable *résumé* of the work of the Geological Survey in Northumberland and Durham, which have been mapped on the 6-inch scale, and published in two sets of "drift maps" and "solid maps" on the 1-inch. He noted the whole sedimentary series from the Silurian to the Trias, the glacial beds, and the numerous intrusive and interbedded igneous rocks. The last paper was an extremely interesting one by Mr. R. H. Tiddeman on concurrent faulting and deposit in Carboniferous times. The author describes three branches of the Craven group of faults, and then shows that there are vast differences between the quality of the Pendleside grits and Bowland shales on one side of the fault and the corresponding Yoredale series on the other, while the 5500 feet of Carboniferous limestone on the north side of the faults is in strong contrast to the 800 feet on the other side, suggesting great differences in the conditions of deposit. As the faults form the boundary between the two types of rocks, as there is no trace of transition there, and as the thickest beds are on the down-throw side, the author suggests that faulting must have gone on contemporaneously with the deposit. A note was appended describing knolls of crystalline limestone full of fossils and bordered by limestone breccias, which were regarded as reefs growing in the Carboniferous ocean.

Reviewing this list of papers, it is obvious that, though many of them were not of a class to interest the somewhat popular audience which listened to them, there are a large number of great scientific interest which mark a very considerable advance made in our knowledge during the past year.

THE BIOLOGICAL PAPERS AT THE BRITISH ASSOCIATION.

As has been the custom for the last few years, a good deal of time was devoted to the discussion of topics of general biological interest. The subjects selected for these discussions were, "The Transmission of Acquired Characters" and "The Utility of Specific Characters," which were respectively opened by Mr. E. B. Poulton, F.R.S., and Prof. Romanes, F.R.S. There were also an extremely large number of botanical and zoological papers, but no physiological papers, owing to the absence of most of the physiologists, who were attending the Physiological Congress at Basle. In the following account only a few of these papers are abstracted, as it would be impossible to do justice to all in a limited space.

Mr. Romanes opened a discussion on specific characters as useful and indifferent. The question to be debated was, whether *all* characters were adaptive, and had been brought about by natural selection, or whether there were not specific characters which had no utilitarian significance? The naturalists who hold the former view were apt to beg the question by assuming that, if a given character could not be explained as due to utilitarian principles, it was simply due to a failure to see the need for it; this way of dealing with the question is really unscientific dogmatism. The author had selected certain groups, and tabulated the various specific characters, placing on one side those which were conceivably of advantage, and on the other side those which were apparently useless; the latter were found to preponderate. This was especially clear in the coloration of birds: to take one instance, the breast and abdomen of woodpeckers are variously coloured, and yet these parts of the body are habitually concealed; here it is most difficult to conceive how natural selection can have been the cause of the various modifications. It must, in fact, be admitted that other influences besides natural selection have led to the production of specific characters which are not in any way useful as such. Sexual selection, in the first place, although Mr. Wallace rejects it, must be considered as important. There is an enormous amount of evidence that climate—as we summarize a vast number of external conditions of life—has a uniform and permanent influence upon specific characters. A striking evidence of this influence is seen in the faunas of caves; here we see a loss of coloration and other peculiarities in the most different groups of animals. It has been attempted to explain this change as due to natural selection acting directly upon their physiological constitutions, and so indirectly upon their colours. This explanation would be reasonable if only one class of animals were concerned; but to assume that representatives of the most diverse classes of animals are acted upon in an identical fashion by natural selection is to assume too much; the changes must be due to the direct influence of the environment. Weismann's use of "panmixia," or negative natural selection, to account for such changes, fails, inasmuch as it should also follow that the fauna of the deep sea, which is exposed to identical conditions as regards darkness, and even temperature, should show an absence of coloration; but it is notorious that the reverse is the case. Again, the rabbits of the island of Porto Santo, near Madeira, which are the progeny of a few pairs introduced in the fifteenth century, differ in certain peculiarities of coloration which cannot be regarded as adaptive: in so short a time as four years some of these rabbits, when brought to England, reverted to the original type; this seems to be the clearest case of the direct influence of climate. Food is known to have a direct influence on coloration, but as yet there is not very much definitely known about these influences; for instance, the bullfinch turns black when fed upon hempseed, and other birds change their colour when fed with cayenne pepper; there can be no doubt that various substances exist in nature which have a similar direct effect upon the plumage of birds which feed upon them. Isolation is another cause of non-beneficial change. So much, then, for specific characters. If the theory of natural selection is good as a theory of the origin of species, it must likewise be good as a theory of the origin of genera; and if specific characters must necessarily all be "useful," so must generic characters. If the doctrine of utility as universal be conceded to fail as regards genera and all the higher taxonomic divisions, it appears inconsistent to maintain that it must necessarily hold as regards species: it is not supposed to hold as regards varieties. This seems to be a most illogical position.

In a paper on the antherozoids of Cryptogams, by Mr. Alfred W. Bennett, the object of the author was to bring out the difference between the two modes in which the ciliated fertilizing organs of Cryptogams are formed, the first type being that which occurs in Vascular Cryptogams, Muscineæ, and Characeæ, the second in Algæ (excluding Characeæ). The essential character of the first type is that the antherozoid is formed from the nucleus only of its mother-cell, the whole of the rest of its protoplasm being consumed in the development of the antherozoid. The vibratile cilia which give to the mature antherozoid its power of rapid movement proceed from a peripheral layer of hyaline protoplasm belonging to the nucleus. In ferns and other vascular cryptogams these cilia are very numerous, forming a tuft attached to the anterior end of the antherozoid. The antherozoids of Muscineæ (Musci and Hepaticæ) and those of Characeæ have only two very long and slender cilia attached in the same position. The structure and mode of development of these organs is almost identical in these two classes. In the Fucaceæ, on the other hand, which may be taken as the highest type of Algæ with ciliated antherozoids, the structure of the antherozoid is altogether different. It is a naked cell, not inclosed in a cellulose-wall, with cytoplasm, nucleus, and pigment-spot; the two cilia both spring from a spot in close proximity to the eye-spot, although one of them is attached to the body of the antherozoid for a portion of its length. The importance of the above facts was pointed out in support of the view that the Characeæ are more nearly related to the Muscineæ than to the true Algæ.

Mr. Poulton read a paper "On the Supposed Transmission of Acquired Characters." The position taken up by Weismann is that acquired characters, *i.e.* characters produced by the incidence of external forces upon the individual body are not in any case inherited. The evidence for such transmission might be direct or indirect; to the former category would belong transmission of mutilations which would be undoubtedly impressed upon the individual body by external influences; the evidence might also be indirect; if it could be shown that evolution was impossible without accepting this principle we should have to accept it. The evidence of transmission of mutilations is not strong, and Prof. Windle has argued very forcibly that monstrosities were due to peculiarities of the ovum and not to external forces. The supposed hereditary effects of use and disuse were unsupported by any proof that the modifications of organs affected by use or disuse had been more complete or more rapid than that of organs not so affected. With regard to instinct, Dr. Romanes had suggested a difficulty—that was, the instinct of certain wasps to sting and paralyze the nerve centres of their prey. But it must be remembered that the benefits arising from this instinct were felt not by the wasps themselves, but by their progeny.

The subject was continued by Mr. Francis Galton, who read a paper entitled, "Feasible Experiments on the Possibility of transmitting Acquired Habits by means of Inheritance," in the course of which he said that feasible experiments have yet to be designed that shall be accepted as crucial tests of the possibility of a parent transmitting a *congenital* aptitude to his children, which he himself possessed, *not congenitally*, but merely through long and distasteful practice under some sort of compulsion. The requirements are to eliminate all possibility of parental or social teaching, to bring up all the descendants in the same way, to make simultaneous experiments on many broods during many generations, and, lastly, to economize time, money, and labour. This list of requirements points with emphasis to experimenting on creatures that are reared from eggs, as fowls, fishes, and moths. *Fowls*.—The largely extending practice of hatching eggs in incubators for commercial purposes, and the varied aptitudes of poultry, make them very suitable subjects. Birds are said to have an instinctive dread of various insects; hence mimetic insects, that are really good for food, are avoided by them. Do such insects exist, and could they be easily reared, which poultry would avoid at first, though experience would soon teach them to like and to eat greedily? Similarly as regards sounds and cries, which would frighten at first, but afterwards be welcomed as signals for food, &c. Would the stocks of two breeders, one of whom adopted such experiments as these and the other did not, differ in instinct after many generations? *Fish*.—The experiment (quoted by Darwin) of Möbius with the pike, using a trough of water divided by a glass plate into two compartments, in one of which was the pike and in the other were minnows, was mentioned as an example. The pike, after dashing at the minnows many times, and each time being checked and hurt by the glass plate, during some weeks, finally abandoned all attempts to seize them, so that when the plate was removed the pike never afterwards ventured to attack the minnows. The question, then, is, whether fish reared for some generations under conditions which compelled them to adopt habits not conformable to their natures would show any corresponding change of instinct. Of course each generation would be reared in a separate tank from its parents. *Moths*.—Experiments have been made for the author by Mr. Frederic Merrifield with *Selenia illustraria*, which has two broods yearly. They are being made for quite another purpose, but have already shown the ease of breeding hardy moths on a large scale when the art of doing so is well understood. All larvæ are fastidious in their diet, but it may well be that certain food which they would not touch at first would after a while be greedily eaten, and be found perfectly wholesome. Ezperiments on the lines here suggested ought to show the proportion of cases in which acquired aptitudes of several kinds are *certainly not* inherited. They might also, perhaps, show that in a small proportion of cases they *certainly are*. Thus limits would be fixed within which doubt remained permissible. The object of this paper is to invite experts to discuss the details of the most appropriate experiments.

Prof. F. O. Bower read a paper on the meristems of ferns as a study in phylogeny. The author has found as the result of examination of the growing points of root, stem, leaf, and of the sporangium in a considerable number of ferns, that as regards their complexity of structure these plants form a natural series, starting from the filmy ferns, which are the simplest, and proceeding through the Polypodiaceæ and Osmundaceæ to the Marattias: in the latter the whole structure of the meristems, as well as of the mature organs of the sporophyte, is bulky and massive, a character which is well suited to growth in subaërial and dry situations; while in the former the whole structure is relatively delicate, and less complex, and suited rather to a subaquatic habitat. A parallel progression from the simpler to the more complex is to be traced also in the prothallus or oophyte of these plants, and the general conclusion is drawn from these observations that the series of the Filicineæ illustrates—perhaps more clearly than any other phylum—the rise of a race of plants from the aquatic to the subaërial habit. Nevertheless they still retain in the mode of fertilization the trace of the aquatic habit, which is only lost in the higher Phanerogamic plants, where the pollen-tube renders unnecessary the presence of fluid water at the moment of fertilization.

The paper by Prof. Hartog, on the structure of *Saprolegnia*, contained an account of the structure of the nucleus and of its division, and also of some remarkable facts concerning fertilization; careful observation showed that nothing whatever passed from the antheridium into the oosphere or the oosporangium during fertilization.

In the paper entitled "Contributions to our Knowledge of the Fresh-water Oligochæta," by Mr. F. E. Beddard, the most important new point was the description of the sexual organs of *Dero*, which have not yet been described; they were stated to agree entirely with those of *Nais*, except that there were no genital setæ.

Mr. Robert Irvine and Dr. G. Sims Woodhead, in their paper on the secretion of carbonate of lime by animals, stated that hens supplied with any salt of lime produce normal egg-shells composed of carbonate of lime. They cannot make shells from magnesium or strontium carbonate. Crustacea, such as crabs, cannot assimilate sulphate of lime from the sea-water to form their exo-skeleton. They can form their shells from calcium chloride. In the egg-shell, the organic and inorganic material are both secreted by cells separated from the epithelial cells. In the crab-shell, the organic material (chitin) remains attached to the epithelial cells, and in this the lime salts are deposited, probably by a process of dialysis, while in the case of bone, the cells are not epithelial in character, the matrix, though separate, is closely associated with the cells, especially during its formation, and the lime is deposited in the matrix, apparently by a process of dialysis. Phosphoric acid, combined with alkalies and alkaline earths, acts as the carrier of the lime salt to the secreting cells. While in the blood, the lime salt is as a phosphate, it may be thrown out mostly as carbonate on meeting nascent carbonic acid at the secreting cells. Lime salts, of whatever form, are deposited only in vitally inactive tissue, such as bone matrix, chitin, or tissues that have undergone degeneration. Although the tissue be dead, deposition may go on. Carbonate of lime may be formed in sea-water as follows: the carbonate of ammonia produced by the decomposition of the effete products of animals, urea, &c., decomposes a portion of the sulphate of lime in the sea-water with the formation of carbonate of lime equivalent in amount to the carbonate of ammonia thus formed.

Sir John Lubbock read a paper on the shape of the oak-leaf and the leaves of the Guelder roses. The leaf of the evergreen oak is small in comparison with that of the English oak, and its margin is entire. During winter the leaf is protected by scales, which are not proportionately larger in the English oak; hence the leaf must be more folded in the bud, and the peculiar shape of the leaf may be shown by models to be due to the shortness of the bud in comparison with the length of the leaf; moreover, the two sides of the leaf are differently curved, hence the asymmetry. With regard to the Guelder roses, there are two species in this country which have very dissimilar leaves: in one form they are oval and very hairy when young; in the other they are trilobate, smooth, and furnished with stipules. In the former species the hairy covering protects the young leaves, but in the latter the outer leaves become tough and leathery, and encircle and protect the younger leaves; this brings about a close packing of the young leaves, which are folded so as to be stowed away in a small space; hence their trifid form. The presence of stipules is always associated with a lobed form of the leaf, and they apparently assume their thread-like form to fill up a space which would otherwise be left empty in the bud.

The object of the paper on the placentation of the dugong, by Sir W. Turner, was to put on record the fact that the placenta of the dugong is zonary and *non*-deciduate; it differs, therefore, in the latter character from the elephant, and in the former from its near ally the manatee.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The summary statement of lectures delivered during the past year shows that about ninety-five courses of lectures have been given in the subjects of the Faculty of Natural Science.

We may note the following among the lectures announced for this term:—

Prof. Sylvester will lecture on the resolution in integers of systems of linear equations with rational coefficients, and will reproduce an unpublished course of lectures given at King's College in 1869, on the relation of the theory of compound partitions of numbers to certain geometrical theories. Prof. Pritchard will lecture on planetary theory and on the Constellations.

Prof. Clifton, magnetism; Mr. Selby, the mathematical theory of electrostatics and magnetism.

Prof. Odling, diacidic olefine acids.

Prof. Green, stratigraphical geology and physical geology; Mr. Badger, palæontology.

Prof. Burdon Sanderson is unfortunately prevented from lecturing by serious illness, and Mr. Gotch and Dr. Haldane will lecture for him.

Dr. Tylor lectures on the development of religions, and Mr. Mackinder on the physical geography of the British Islands.

In the Medical Faculty, Mr. Thomson lectures on osteology, Dr. Collier on the methods of diagnosing disease of the heart, and Mr. Morgan on clinical surgery.

Scholarships and Exhibitions in Natural Science are offered for competition before Christmas by Balliol, Christ Church, and Trinity, and by Keble College.

CAMBRIDGE.—The Vice-Chancellor (Dr. Searle), in laying down his office, was able to relate that the executors of Mr. Newall had agreed to the conditions proposed to be made by the Senate as to the great telescope to be given to the University. The expense of transit, re-erection, and permanent work in promotion of stellar physics will be considerable.

The election of Mr. Jenkinson as Librarian gives the University an official who, in addition to his well-known classical and literary accomplishments, has no mean scientific qualifications. He was for some time Curator in Zoology, and is a member of the Botanic Gardens Syndicate and of the Council of the Cambridge Antiquarian Society. Men of science cannot regret Mr. Clark's retirement from the contest, for he literally could not be spared from the Museums, though otherwise highly qualified for the Librarianship.

There are very few new features in the science lectures this term. The list is, if anything, slightly longer, and would fill two of our pages; but there is nothing in it calling for special comment.

SCIENTIFIC SERIALS.

THE *American Meteorological Journal* for September contains (1) an article by Prof. H. A. Hazen on cloud formation. The author considers that theories of storm generation and cloud formation are unsatisfactory. He has made a number of experiments, both with dry and damp air, on the formation of cloud by the cooling produced by exhaustion, the result being that he finds the amount of the latter to be only about one-fourth of what theory would indicate. The results obtained with dry and moist air were almost exactly the same. (2) State tornado charts for Alabama and Ohio, by Lieutenant Finley. (3) An article on the verification of weather forecasts, by H. Helm Clayton. He points out that all the methods adopted admit of considerable latitude in interpreting phenomena, so that the same forecasts, when verified by different persons, may differ widely as to the percentage of success, and he suggests an arrangement which may be applied to areas as well as to single stations, and which, at the same time, might be useful in studying the relative frequency of each phenomenon. (4) The distribution of wind velocities in the United States, by Dr. F. Waldo, deduced from the records of the self-recording anemometers at the stations of the Signal Service. In this article, which is unfinished, the author deals exclusively with the values of the constants derived from various anemometrical experiments in Germany and Russia.

THE *Meteorologische Zeitschrift* for September 1889 contains a discussion, by Dr. J. Hann, of Parts iv. and v. of "Contributions to our Knowledge of the Meteorology of the Arctic